

Sustainable Intensification of Cereal-Based Farming Systems in Ghana's Guinea Savanna

Constraints and Opportunities Identified with Local Communities

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The Africa Research in Sustainable Intensification for the Next Generation (Africa RISING) program comprises three research-for-development projects supported by the United States Agency for International Development as part of the US government's Feed the Future (FtF) initiative.

Through action research and development partnerships, Africa RISING will create opportunities for smallholder farm households to move out of hunger and poverty through sustainably intensified farming systems that improve food, nutrition, and income security, particularly for women and children, and conserve or enhance the natural resource base.

The three projects are led by the International Institute of Tropical Agriculture (in West Africa and East and Southern Africa) and the International Livestock Research Institute (in the Ethiopian Highlands). The International Food Policy Research Institute leads an associated project on monitoring, evaluation, and impact assessment.



Citation

Ellis-Jones J., A. Larbi, I. Hoeschle-Zeledon, I. Y. Dugje, I. A. Teli, S. S. J. Buah, R. A. L. Kanton, J. M. Kombiok, A. Y. Kamara, and I. Gyamfi. 2012. Sustainable intensification of cereal-based farming systems in Ghana's Guinea savanna: constraints and opportunities identified with local communities. IITA report. IITA, Ibadan, Nigeria. 22 pp.

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ISBN: 978-978-8444-11-4

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Cover photograph

Community analysis at Kpachi village in the Northern Region of Ghana (A. Larbi)

Acknowledgements

This report documents 47 community analyses undertaken by multi-disciplinary facilitation teams in the Northern, Upper West and Upper East Regions of Ghana. Each involved discussions with community members and local leaders. As such we would like to acknowledge the input of the over 4000 men, women, and young people who provided their valuable time and local knowledge in sharing their experiences and ideas for the future, as well as helping us to forge a way forward for the Africa RISING Ghana project.

The present document is based on the full community analyses report prepared by Dr. Dugje, Mr. Teli, and others, and which can be downloaded from <http://cgspace.cgiar.org/handle/10568/25070>.

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Summary

This report summarizes the results of discussions with 47 communities and local leaders undertaken by multidisciplinary facilitation teams in the Northern, Upper West, and Upper East Regions of Ghana. This first phase of a participatory research and extension process, involved community engagement and social mobilization supported by communities' own analysis of their existing situation.

Each region is dominated by cereal and legume cropping systems with livestock also providing an important source of food and cash. Major crop production constraints include low and declining soil fertility, a lack of improved seed, problems of pests, disease, and weeds especially *Striga*, a lack of draft power and equipment, and the high cost of agri-inputs associated with each. These problems are compounded by erratic rainfall and drought, floods, bush burning, deforestation, and destruction of farm land though small-scale mining in some areas. At the same time local communities raised concerns about lack of crop storage facilities, postharvest pest and disease problems, and lack of knowledge about processing with little or no processing equipment, compounded by low market prices, inadequate access roads, and poor transport facilities. With regards to livestock, community-raised problems included pests and diseases, poor access to veterinary services leading to high mortality rates, compounded by a lack of improved breeds, and inadequate grazing and watering points in many areas.

The major trend across the three regions is increasing maize, decreasing sorghum and millet production with generally static legume production, apart from soybean which is increasing in some areas. This is due to its low production cost and ready market providing an important income source, particularly for women. However, lack of soybean utilization knowledge and processing skills are limiting production in other areas. With regards to livestock, small ruminants and poultry production in particular are increasing in those areas where disease is not a major problem.

A wide range of research and development (R&D) agencies and community-based organizations (CBOs) were identified including Government, international agencies, international, faith-based, and local nongovernmental organizations (NGOs) and a few private sector organizations. One hundred and sixty CBOs including men's, women's, mixed gender, and youth groups were identified, some operating independently but many requiring ongoing support and capacity building.

Key interventions for the way forward were identified. These include the introduction of a number of improved sustainable land and livestock management practices supported with training not only in production, utilization, and processing skills but also leadership, marketing, and communication skills to encourage farmer-to-farmer learning and extension. At the same time advocacy to promote improved policies to reduce land degradation, improve market infrastructure and build partnerships will be required. These will require community and local leadership involvement in planning appropriate interventions, trying out new ideas through farmer experimentation, and, importantly, monitoring the process through lesson learning and experience sharing.

Introduction

Background

Rural livelihoods in West Africa are mainly agro-based and dependent largely on crop and livestock production, processing, and subsequent marketing. Farmers produce cereals, legumes, vegetables and fruit trees and keep livestock (Blench 2006a). However, optimal system productivity is limited by socioeconomic, biophysical, institutional, financial, and sometimes, policy constraints. Farmers' dependence on traditional methods of agricultural production without improved interventions has often resulted in environmental degradation, poverty, food insecurity, and malnutrition especially among the most vulnerable. Up until recently, development in rural communities has often entailed extension agents advising or teaching farmers about "best practices" developed by researchers, with little community participation in their identification or development. Unfortunately this often resulted in low or zero adoption of new technologies. The Africa RISING–Ghana Project is using a research-for-development (R4D) strategy for targeting sustainable intensification of cereal/legume farming systems in the Guinea savanna area of Ghana.

The Project is funded by the United States Agency for International Development (USAID) through the "Feed the Future" support and is coordinated by the International Institute of Tropical Agriculture (IITA) in Ibadan. The project goal is to provide pathways out of hunger and poverty for smallholder families in the region, particularly women and children.

A participatory research and extension approach

The project uses a participatory research and extension approach (PREA) (Ellis-Jones et al. 2005 and Hagmann et al. 1999), which encompasses four principle phases. The first involves community engagement and social mobilization, requiring a facilitation process for communities' own analysis of their existing situation. This is reported here. The remaining phases include community level action planning based on the opportunities identified; implementation through trying out new ideas involving farmer experimentation; and monitoring the process through sharing experiences and lesson learning. This will include an assessment of the PREA process, allowing modification for repeating in the second and subsequent years.

PREA entails involving farmers in a continuous process from definition of a R&D agenda, conduct of research, evaluation of results, and promotion of findings. PREA requires facilitation of local communities in an analysis of their farming systems, identification of constraints, and the search for solutions and new opportunities. This requires the building of strong links between stakeholders, with local communities, extension agents, researchers, and the private sector working as partners, and encouraging farmer-to-farmer extension of appropriate technologies and new knowledge. The partnerships established during the PREA process can be regarded as innovation platforms, where initially R&D agents provide leadership with active participation of local communities and the private sector. In time ownership and leadership should be transferred to local communities with the R&D organizations continuing to provide back-up support services. Ongoing participation by the private sector will largely depend on commercial opportunity. Such partnerships or platforms should survive beyond the life of the project and contribute to sustainability of project achievements.

The agro-environment

The Guinea savanna area in Ghana comprises three administrative regions in the north of the country, the Upper West, the Upper East, and the Northern regions. These fall within two main agroecological zones (AEZs), the Northern Guinea and Southern Guinea savannas (Map 1), which occur across much of West Africa. The climate of both AEZs is relatively dry, with a single rainy season that begins in April and ends in October, with a mean annual rainfall that varies between 900 and 1200 mm, with lower rainfall in the north and increasing southwards. The dry season starts in November and ends in March or April with maximum temperatures occurring towards the end of March-April and minimum in December and January. *Harmattan* winds, which occur during the months of December to early February, have a considerable effect on the temperatures in the region, which may vary between 14 °C at night and 40 °C during the day.



Map 1. The three administrative regions and two agroecological zones.

The prevailing climatic conditions are rainfall for half the year, with the remaining period being very dry and hot, registering practically no rains. This coupled with a generally gentle relief are conducive to alternating wetness and dryness resulting in extensive occurrence of shallow soils often overlying impenetrable ironpan or laterite. These have been classified locally as groundwater laterites typically sandy loams with gravel across some areas. These are by far the most extensive soils occurring within the savanna zones (Obeng 2000; FAO 1967). These support small land holdings of low input-output farming systems with low yields and consequent household food and nutritional insecurity. Major problems raised by farmers were declining soil fertility and declining crop yields largely due to continuous cereal cropping and deforestation.

The Northern Region is characteristically savanna becoming increasingly Sudano-Sahel in the extreme Upper East and Upper West Regions as rainfall decreases. One of the characteristics of these semi-arid savannas is the unpredictability of the onset and establishment of rainfall, with droughts both between and within seasons. Increasingly erratic rains were often mentioned by farmers as a concern among the array of problems identified during the community analyses.

The semi-arid climatic conditions and fragile soils of all three regions have hitherto supported sorghum and millet-based farming systems. These will need consistent amelioration to support the emerging maize-based system. There will therefore be a need to focus on interventions that will improve soil fertility and increase soil moisture availability during the greater part of the rainy season.

Population and ethnic groups

The three regions are generally not densely populated and sometimes under cultivated with communities living in clustered settlements. The Upper West, being the driest area, has the lowest population density with the natural vegetation often being underutilized, contrasting with often serious deforestation in the Upper East and North.

Individual communities have populations that range from less than 200 in the sparsely populated areas to over 4000 in more densely populated areas. There are a wide range of different ethnic groups who speak many languages (Table 1), although Hausa, Dagbanli, and Waali serve as *lingua franca* and act as a medium of communication.

Table 1. Main ethnic groups and *lingua franca* across the regions.

Region	Main ethnic groups	<i>Lingua franca</i>
Northern	Dagomba, Mamprusi, Komkomba Chokosi, Gonja, Fulani, Ewe, Frafra, Dagarti, Sisala, Waala, Akan and Grunsi	Hausa and Dagbanli
Upper East	Kusasi, Moshie, Busasi, Mamprusi, Bisa, Fulani, Hausa and Zabarma	Hausa and Waali
Upper West	Dagaaba, Waala, Lobbis, Sissala and Chakali	Hausa and Waali

Community analyses objectives and approach used

The main objectives of the community engagement and analyses were to:

- Share knowledge and gain information about people's livelihoods in local communities especially in relation to crop and livestock production systems, processing, and marketing.
- Identify constraints and opportunities for improving people's livelihoods.
- Assess existing technology options, coping strategies, and opportunities for improvement.
- Identify entry points with key stakeholders for testing selected new technology options to ensure sustainable development.
- Identify community-based organizations and community leaders with whom to work in testing technology options and addressing constraints that might limit adoption.

Community engagement and situation analyses were undertaken after facilitator training at a stakeholder workshop on the use of appropriate methods and tools. This was followed by a field survey over the period 9–21 May 2012, in 47 communities across 10 districts in the Northern, Upper East, and Upper West Regions (Table 2).

The number of people participating in each community ranged from around 50 to over 100 individuals, often involving more women than men, with over 4000 people participating across the three regions. The discussions provided an opportunity for mobilizing and encouraging communities to undertake an analysis of their own situation, and identify and prioritize constraints and opportunities for resolving their problems.

The data shared and collected in each community included:

- Information on the numbers of men and women, the main ethnic groups, and natural resources of the area.
- Identification and priority ranking of the crops grown and livestock kept for food and cash purposes with preferences by men, women, and youth.
- Production trends of crop and livestock and the reasons for this.
- Existing crop and livestock processing and marketing and preferences by men, women, and youth.
- Priority ranking of problems and coping strategies for each problem.
- Opportunities for the way forward.

In each community, discussions were facilitated in separate groups of men, women, and youth before sharing the information in general meetings. This encouraged free discussion while allowing information to be widely shared between community members, research, and extension staff.

Table 2. Location of community analyses by District and Region.

Region	District	Community	Participants
Northern	West Gonja	Busunu, Sori No.1, Damongo Zongo, Jonokponto, Frafra No.4	
	Savelugu/ Nanton	Duko, Libga, Kanshegu, Jana, Manguli	604 men
	Talon/Kumbungu	Dundo, Kpachi, Tingoli, Zugu, Sabegu	614 women
	Yendi	Zang, Zakoli	
Upper East	Talensi/ Nabdam	Sakote, Winkogo, Balungu, Baare, Sheaga,	
	Bongo	Gowrie, Beo Moshe, Soe Yidongo, Namoo Abass, Dua	1017 men
	Bawku West	Binaba, Tilli, Tanga, Yarigu, Googo	1077 women
	Bawku Municipal	Binduri, Nayoko, Ninkogo, Kaade, Nafkolga	
Upper West	Nadowli	Tabiesi, Goriyiri, Ombo, Daffiama, Kalsegra	404 men
	Wa East	Loggu, Bulenga, Kpalinye, Naaha, Zinnyea	336 women

Community analyses

Existing farming systems

Reports from communities confirmed that cropping systems are dominated by cereals and legumes, the main cereals being, maize, sorghum, rice, and millet with early and late millet being differentiated particularly in the Upper East. The relative importance of each cereal differed both between and within regions and sometimes between men, women, and youth.

Maize was largely regarded as the most important crop for both food and cash except in the Upper East where early millet is preferred as a food, largely because grain becomes available while other crops are still growing (Table 3). Rice is regarded as an important cash crop in the Upper East, especially by women.

The four main legumes grown are groundnut, cowpea, soybean, and bambaranut with Kersting's groundnuts and pigeon pea being grown as minor crops in the Upper West and North, respectively. Groundnut and cowpea are the most important across regions for both food and cash with cowpea being a particularly important cash crop in the Upper East. While men tend to be more involved with cereals, women play a greater role in legume production and their subsequent processing and sale.

Other crops of some economic importance that contribute to livelihoods include yam, sweetpotato, cassava, tomato, onion, pepper, mango, citrus, and banana.

Table 3. Priority ranking of cereals, legumes and livestock across the three regions.

	Upper East								Upper West				North					
	n	All	Food			Cash			n	All	Food	Cash	n	All	M	W	Y	
			M	W	Y	M	W	Y										
Cereals																		
Maize	46	1	2	2	1	1	1	1	19	1	1	1	27	1	1	1	1	
Sorghum	46	2	4	3	4	2	3	5	19	2	2	2	22	3	3	3	3	
Rice	46	4	5	5	3	3	2	2	19	3	3	3	22	2	2	1	2	
Early millet/ millet	46	2	1	1	1	4	5	3	19	4	4	4	12	4	4	4	4	
Late millet	46	5	3	3	2	5	4	3	–	–	–	–	–	–	–	–	–	
Legumes																		
Groundnut	46	2	1	1	3	2	2	2	19	1	1	1	27	1	1	1	1	
Cowpea	46	1	2	2	1	1	1	1	19	2	2	2	22	3	2	3	3	
Soybean	46	4	4	4	4	4	4	4	19	3	3	4	24	2	3	1	2	
Bambaranut	46	3	3	3	2	3	3	3	17	4	4	3	16	4	4	4	4	
Kersting’s groundnut	–	–	–	–	–	–	–	–	2	5	5	5	–	–	–	–	–	
Pigeon pea	–	–	–	–	–	–	–	–	–	–	–	–	5	5	5	5	5	
Livestock																		
Poultry	46	1	1	1	1	1	1	6	19	3	2	3	25	1	1	1	1	
Goats	46	2	2	2	2	2	2	3	19	2	1	2	25	2	3	3	2	
Sheep	46	3	4	3	3	2	3	2	19	3	4	5	25	2	2	4	3	
Cattle	41	5	5	6	5	5	6	1	16	3	3	1	18	5	4	2	5	
Pigs	46	4	6	5	4	4	4	4	16	3	5	4	2	3		5	4	
Donkeys	34	7	7	7	7	7	6	7	2	6	7	7	–	–	–	–	–	
Dogs	23	5	2	4	6	6	5	5	–	–	–	–	–	–	–	–	–	
Rabbits	–	–	–	–	–	–	–	–	4	6	1	1	–	–	–	–	–	

n = Number of communities where crop or livestock were mentioned, M = Men, W = Women, Y = Youth.

Poultry, goats, sheep, and cattle were the most widely kept livestock species across regions with poultry being the most important for both food and cash, followed by the small ruminants, goats, and sheep. Cattle were favored by the youth especially for selling. Although pigs were kept across regions, they were more widely kept in the Upper East, where donkeys and dogs were also kept. Rabbits were noted in some communities in the Upper West.

Constraints associated with crops and livestock

Many interrelated constraints were identified across regions, in some areas being prioritized and in others merely identified (Table 4). Most serious were low and declining soil fertility, lack of improved seed, problems of pests, disease and weeds, and the high cost of agri-inputs associated with each. Other serious problems mentioned across regions included increasingly erratic rainfall and drought both between and within seasons, poor land preparation due to lack of draft power and equipment, *Striga* infestation, and lack of production credit, more especially for women and youth. Other problems mentioned in the Upper East were poor extension coverage, flooding in some areas, inadequate land (this being the region with the highest population density), and destruction of crops by livestock.

Table 4. Major production, processing, and marketing constraints in each region.

Constraints	Upper East	Upper West ¹	North ¹
Crop			
Lack improved seeds/high cost	x	1	2=
Low/declining soil fertility/high input cost	x	2	2=
Pests, diseases and weeds/high input cost	x	3	1
Drought/unreliable/erratic/rainfall	x	4	4
Inadequate land prep/lack of equipment	x	5	5
<i>Striga</i> infestation	x	6	6
Lack of credit	x	7	7
Poor extension coverage	x	–	–
Flooding	x	–	–
Inadequate land	x	–	–
Livestock destruction of crops	x	–	–
Processing and marketing			
Lack of storage facilities	–	x	x
Postharvest pest and disease losses	x	–	–
Lack of knowledge on processing	x	–	–
Lack of processing equipment	x	x	x
Lack of an organized market	–	x	x
Low produce price/demand	x	x	x
Lack of transport	–	x	x
Exploitation by middlemen	x		–
Livestock production			
Poor access to veterinary services	x	x	x
Diseases	x	x	x
PPR	x	–	–
Mange	x	–	x
Anthrax	x	–	–
Newcastle Disease	x	–	x
African swine fever	x	–	–
Worms and ticks	x	–	x
Diarroea/pneumonia	–	–	x
High mortality rates	x	x	x
Lack of improved breeds	x	–	–
Inadequate grazing	x	x	–
Inadequate watering points	x	x	–

x = Problem identified but not ranked, 1 = Ranking of crop production problems (1 = highest).

With regards to processing and marketing, serious constraints included lack of crop storage facilities leading to postharvest pest and disease problems, lack of knowledge about processing, and lack of processing equipment, for instance, groundnut shellers, dryers and grinding mills, which limited opportunities for adding value. At the same time concerns were raised about lack of organized local markets, low market prices, inadequate access roads, poor transport facilities, and sometimes low demand for farm produce.

With regards to livestock, poor access to veterinary services, and pest and diseases leading to high mortality rates were of major concern. These were compounded by a lack of improved breeds, inadequate grazing, watering points—all mentioned as problems limiting production.

Processing

Processed foods are produced from most cereals and legumes with processing being undertaken largely during the dry season, largely by women and their daughters. Processed products are used for both domestic consumption and cash sale, providing an important supplement to family and women's incomes. Ease of processing, multiple products, and a ready market have all contributed to an increase in processing activities. However lack of processing skills, suitable equipment, and limited crop yields limit the amount of processing taking place. In the absence of local markets, middlemen from district and regional towns are often involved in purchasing sorghum and soybean products.

Among the cereals, sorghum is processed into *pito*, a local brew in high demand with a ready market. Maize is processed into flour for food or sale as *kenkey* and *banku*, millet is used in preparing millet cakes, *koko*, a watery porridge and *masah*, a fried paste. Among legumes, groundnuts are processed into oil, paste, and cake with the oil often having to compete with other cheaper cooking oils. Soybean is processed into *dawadawa* with the crop gradually replacing groundnuts because of declining groundnut yields. This is despite *dawadawa* being the only soybean recipe known. Cowpeas remain popular and are processed into many local recipes.

Processing of livestock products is not common other than for domestic consumption, local ceremonies, and rituals. Sheep and goats are processed by both households and local butchers and often used in funeral and child naming ceremonies, whilst cattle are often sold to local butchers who sell the meat directly to consumers. Men tend to be more involved in the processing of animals into *kebab* with women more involved when meat is smoked or fried for subsequent sale.

Crop and livestock production trends

The major trend across all regions is increasing maize production, with maize regarded as a new crop with high yield potential, especially when new varieties and inorganic fertilizers are used. At the same time increasing market opportunities for maize and maize products were reported. Consequently maize is now gaining dominance over sorghum and millet both as a cash and a food crop so the production of sorghum and millet is decreasing in most communities, reasons being the increasingly erratic rainfall, declining soil fertility, poor management practices, and *Striga* infestation. This also applies to rice in some communities whilst in others, rice production is increasing, particularly in the Upper West due to the availability and use of new varieties and improved management practices.

Legume production trends are generally mixed, increasing in some communities due to availability of improved seed with increased drought tolerance. In other communities legume production is declining again due to erratic rainfall, declining soil fertility, pests and diseases, and unavailability of improved varieties. This was particularly so for groundnut, bambaranut, and cowpea, which are badly affected by pests. Soybean, like maize is regarded as a new crop with production increasing the reasons given that the crop is easy and low cost to produce, and doesn't require external inputs such as fertilizer and pesticides. At the same time soybean is considered a nutritious food with a ready market providing income, particularly for women. However, a lack of utilization knowledge and processing skills were reasons advanced for a decline in soybean production in some areas. Cowpea production is increasing across those areas where improved management practices are being utilized. These include use of improved varieties and appropriate pest control practices. Where seed and pest control practices are not available production is decreasing.

Generally livestock production especially small ruminants (goats and sheep) and poultry is increasing particularly for ceremonial functions, paying bride price as well as providing a means of saving and source of income when required. Poultry are particularly popular and have multiple uses in rituals, spiritual uses, festivals, payment of dowry as well as being regarded as a high quality food and when sold, a quick means of obtaining cash. However some communities did report decreasing production as a result of high bird mortality especially from Newcastle disease.

With regards to cattle, trends are mixed, sometimes decreasing, for instance in two northern districts cattle theft is a serious problem, while in another two districts, cattle numbers are increasing as they provide a stable source of income as well as being a store and an indicator of wealth.

In parts of the Upper East, livestock production is decreasing for all categories except poultry despite incidences of Newcastle disease. High cost of food, drugs and housing, livestock theft, and inadequate grazing were the major reasons given for the decrease. Rabies incidence in dogs was also rising in some areas. However in Bawku municipal the prolificacy of small ruminants and pigs and their ability to provide ready cash was encouraging increased production. At the same time shortage of draft animals meant that use of donkeys as work animals was increasing.

In the Upper West, livestock production was reported as generally increasing due to improved veterinary services, availability of pasture, and good market prices. For instance an increase in cattle and rabbits were reported in Tabiase and donkeys in Goriyiri due to improved health care. At the same time good cattle husbandry provided by the Fulani owners was resulting in increased cattle numbers. However, the decline in some communities was also reported largely due to an increase in diseases, high mortality, high incidence of theft, and poor management.

Input and output marketing

Most communities do not have organized local market days, these being largely restricted to district and regional capitals. At present farm produce often has to be taken to distant markets along poor roads that attract high transport costs. At the same time poor transport links between communities affects inter-community movement of farm produce with resulting weak market access. Consequently there is little incentive to increase productivity due to low farm produce prices received. In addition there are few buyers who visit the communities and farmers complain of exploitation by middlemen, more especially in the Upper West. Equally there are few local agro-dealers, so farmers also depend on district and regional markets for purchasing farm inputs. This results in high input costs.

These constraints present serious problems for intensification and the development of profitable market-driven, value-added agriculture. Improving links between farmers and input-output markets are a prerequisite but this requires substantial improvement in market infrastructure, processing, and marketing skills. To make this a reality requires community leaders and policymakers to promote the establishment of community markets and market infrastructure development particularly improved road access. Better input and output market links have the potential to increase crop yields substantially and result in improved farm incomes. This will also require improved access to credit. However inadequate credit access has been ranked as a high priority constraint especially by women and youth preventing farmers from paying for inputs and farm operations.

If as is likely, maize emerges as the major cereal food and cash crop, increasing soybean production will provide opportunity to augment soil fertility and reduce *Striga* infestation, two major emerging challenges. For instance maize grown in rotation with soybean can help sustain land productivity. At the same time, oil processing and feed milling agro-industries in the larger towns can be linked to soybean producing communities for ready supplies. Both middlemen and processors can provide a ready market for farm produce provided the volumes of production are attractive to buyers.

Capacity strengthening for community members, especially women in soybean value addition will improve its utilization, household nutrition, and income as well as encouraging further production. However at present a lack of knowledge and skills for soybean processing and low prices are major factors limiting its production.

Shocks, constraints, and coping strategies

The main shocks reported by communities across the regions included drought, flood, bush burning, deforestation, and destruction of farm land though small-scale mining and charcoal making, the latter three being considered major causes of drought and the increasingly erratic rainfall. Hence bush burning and destruction of farm land by small-scale miners were considered the most serious issues to be addressed. Although all groups in the community were considered vulnerable, women and youth were considered most affected, as they tend to have poorer access to land than men.

The main coping strategies reported for the shocks and constraints experienced are summarized in Table 5. These include the use of local varieties to overcome problems of the lack and high cost of improved seed, although it was widely recognized that local varieties were late maturing and gave low yields. Problems of declining soil fertility were being addressed through application of manure and inorganic fertilizer, but again availability and high cost were concerns. It was recognized that weed, pest, and disease problems could be overcome by use of herbicides and pesticides, but concerns about availability, the high cost, and hazards for people and livestock limited their use. Problems of land preparation were being addressed through increasing use of draft animals, but insufficient availability of animals often led to late planting.

Table 5. Shocks, constraints, and some coping strategies.

Constraints	Coping strategies	Issues raised
Crop production		
Drought/unreliable/erratic/rainfall	Plant early maturing and drought tolerant varieties	Seed unavailability
Lack of improved seeds/high cost	Conserve water by creating earth bunds	High labor input required
Low/declining soil fertility/high input cost	Local varieties are used in the absence of improved varieties	Low cost, timely availability, but late maturity and low yields of local seed
	Application of manure and chemical fertilizers	Manure available locally, but limited quantities
		Unavailability and high cost of inorganic fertilizers
Pests, diseases and weeds/high input cost	Insecticide use to control insect pests especially on cowpeas	High cost of transport
	Herbicides to control weeds	Unavailability and high cost
		Hazard to people and livestock unless used safely
Inadequate land preparation and lack of equipment	Use of animal traction	Lack of sprayers
		Can be used when no tractors available
		Inadequate and late availability of animals often resulting in late planting
<i>Striga</i> infestation	Intercropping of cereals with legumes to reduce <i>Striga</i> infestation	Does not always give adequate control
	Use of crop rotations	
	Use of fertilizer	
Poor extension coverage	Hand weeding	
Flooding	Farmer to farmer information sharing	Inadequate farmer knowledge
	Avoid flood prone areas	Increasing need to use low lying areas due to population pressure
Bush burning and mining	Dry season cropping	Problem still persists
	Community education for limiting mining operations	
Processing and marketing		
Lack of storage facilities	Use of PICS bags for cowpea storage	High cost and availability
Postharvest pest and disease losses		
Lack of organized local markets	Produce is taken to distant markets	High transport costs
	Sale to middlemen	Low prices
		Exploitation by middle men

Typical coping strategies for the increasing spread of *Striga* included intercropping of cereals with legumes, use of crop rotations, use of fertilizer, and hand weeding. It was however of concern that *Striga* still remained a serious problem. Other coping strategies included farmer sharing of knowledge, where extension coverage was considered inadequate; community education to overcome problems of mining and bush burning; avoiding the use of areas prone to flooding in the rainy season; and using such areas for dry season cultivation, although clearly these coping strategies were often not overcoming the problem.

With regards to postharvest problems and lack of storage facilities, triple bagging (PICS bags) had been introduced in some communities, but lack of organized local markets meant that produce had to be taken to distant markets at high cost and is often sold at low prices.

Community-based organizations and links with research and development organizations

Government, NGOs, and other R&D organizations are present in many communities especially near district and regional capitals, with both individual households and CBOs benefiting from the livelihood support services provided. A wide range of R&D agencies were identified by the communities, including Government, international agencies, international, faith-based and local NGOs, a few private sector organizations as well as ongoing projects. While some worked across the three regions, others had specific community focuses.

A wide variety of support and development services have and are being provided ranging from technology dissemination, provision of agro-inputs on credit usually for repayment in kind, improved water supplies, education, health, to household support. Although support may have been received, in many cases communities were often unaware of agency names, referring to them by either the kind of support provided or names of project staff. Opportunity was identified for greater coordination of many projects and programs linking stakeholders and promoting partnerships between the different organizations.

Some 160 CBOs were identified in the communities, 48 in Northern Region, 79 in the Upper East, and 33 in the Upper West (Table 6).

These included men's, women's, mixed gender, and youth groups, many being formed as a result of support from NGOs. Some of the identified CBOs had formed very recently, some being less than a year old while others had been in existence for over 15 years. Often those in existence for some time have been registered and are now operating independently operating with their own bank accounts. However many, often those more recently formed, remain less formal and unregistered. It was noted that any intervention will need to provide capacity building not only in technical skills, but also in leadership, communication, financial, and marketing skills.

Table 6. Number of CBOs identified across communities.

Region	District	Community and number of CBOs identified	Total across regions
Northern	West Gonja	Busunu-4, Sori No.1-6, Damongo Zongo-3, Jonokponto-5, Frafra No.4-6	48
	Savelugu/ Nanton	Duko-4, Libga-5, Kanshegu-4, Jana-1 , Manguli-1	
	Talon/Kumbungu	Dundo-2 , Kpachi-2, Tingoli-3, Zugu-2, Sabegu-2	
	Yendi	Zang-2, Zakoli-2	
Upper East	Talensi/ Nabdam	Sakote-6, Winkogo-4, Balungu-2, Baare-5, Sheaga-4	79
	Bongo	Gowrie-5, Beo Moshe-3, Soe Yidongo-3, Namoo Abass-2, Dua-6	
	Bawku West	Binaba-7, Tilli--, Tanga-7, Yarigu-5, Googo-3	
	Bawku Municipal	Binduri-1, Nayoko-8, Ninkogo--, Kaade-5, Nafkolga-2	
Upper West	Nadowli	Tabiesi-3, Goriyiri--, Ombo-2, Daffiama-5, Kalsegra-3	33
	Wa East	Loggu-4, Bulenga-6, Kpalinye-3, Naaha-4, Zinnyea-3	

Research and development opportunities

Sustainable agriculture requires natural resource conservation balanced with meeting the needs of improved food and nutritional security, poverty alleviation, and increased household incomes. This in turn requires a focus on system integration, agrodiversity, ecological friendliness, equity, humaneness, adaptation, economic viability, and social justice.

There is indication that competition for use of natural resources is increasing as demonstrated by an increase in incidences of shocks including floods, drought, bush burning, and activities of the small miners that destroy the top soils and charcoal gatherers that increase the rate of deforestation. This is especially the case in the Northern and Upper West regions where charcoal gatherers pose a serious threat to the environment. Land degradation is most acute in the Upper East region where population density is highest and the vegetation and soils have been depleted by frequent bush burning and continuous cultivation. Hence improved land management will be essential for sustaining agricultural productivity in the fragile ecosystem of the Upper East and the human endangered ecology in the Upper West and Northern regions.

The ongoing decline in soil fertility and increase in *Striga* infestation across all regions is an indication of increasing continuous cultivation, probably as a result of increasing population and shortage of land. The fact that shortage of grazing land was mentioned as major reason for the decline in production of cattle and donkeys is a clear indication of land shortage.

Increasing farmer demand for fertilizers is also a clear indication that much of the cultivated land has been depleted of its natural fertility. Observations across regions however indicate that there is large expanse of land in the Northern and Upper West regions, which are still fallow with high levels of natural fertility. Blench (2006b) aptly described this zone as being under populated and under cultivated. This expanse of land will be readily available for food production as competition for community lands become more acute and crop yields continue to decline in the areas that are presently habited and becoming progressively marginal.

Some communities have other resources providing opportunity for utilization. These include low lying areas and inland valleys that can be utilized for rice production and irrigation farming; burrow pits or dug outs for fish production and animal watering points; and inaccessible land and grazing areas that could be effectively used in improved cereal–legume rotations with close crop–livestock interaction.

The promotion of improved crop management practices, notably the use of improved varieties and fertilizer with increased income from maize, are likely to be major catalysts for an ongoing increase in maize production. Already farmers realize higher yields and income from maize than from sorghum or millet, although the latter two are still considered important for food security as they produce adequate yields in poor soils and under low moisture regimes. However, the shift to maize will change the farming system and could adversely influence food security in the region. It would therefore be desirable to promote the production of extra-early and early maturing maize varieties along with legumes. Since production of groundnut, cowpea, and soybean is increasing in many areas, opportunity is provided to promote increased cereal–legume integration improving both crop productivity and agrodiversity.

Since livestock production of poultry, sheep, goats, pigs, and cattle is also increasing for both food and cash, the opportunity is also provided for increased crop–livestock integration, involving the use of manure for crop production and use of crop residues for livestock feed. At the same time encouraging the use of cattle and donkeys for animal traction can help to resolve constraints in land preparation. System integration of crops and livestock can be either in-situ or ex-situ. In-situ integration involves the same farmer producing both crops and livestock and ensures flow of resources between enterprises, while ex-situ is where crops and livestock are produced by different farmers, but with resources exchanged between their respective crop or livestock enterprises. For instance, lease of land by crop farmers to Fulani herders immediately after harvest for grazing of crop residues is a good example of ex-situ integration. This provides feed to Fulani cattle, while soil fertility is increased by the animal droppings.

The way forward

The R4D strategy and PREA processes being used in this project utilize a four phase-approach, the first of which, community engagement and social mobilization, facilitating the communities own analysis of their situation preparing has now been completed. The remaining phases include community level action planning; implementation through trying out new ideas based on researcher and farmer experimentation; and monitoring the process through lesson learning and sharing experiences. If R&D activities are to be owned by the community, two key pre-conditions need to be in place, real motivation and enthusiasm by the community, and effective community organizations which can support the development process and take it forward. This requires committed involvement by CBOs in selecting their own representatives for participation in R&D activities. At the same time development partners including local communities and their leaders, research and development organizations, and the private sector need to ensure a coordinated action plan to which they all agree, implement, and monitor.

The way forward needs therefore to consider a series of interrelated activities including local community and partner capacity building that includes not only production and marketing interventions but also leadership and communication training and policy advocacy. These include:

Crop production and soil management interventions

- Promoting sustainable land management practices to reverse land degradation and sustain system productivity.
- Sourcing improved soil management and crop varieties that are early or extra early maturing, *Striga* and/or drought tolerant and disease/pest resistant from research institutes for on farm-testing after validating on-station in mother trials.
- Testing farmers' coping strategies along with other best practices in on-farm testing to generate solutions to the constraints and opportunities identified. This will involve CBOs and their selected representatives in on-farm research.
- Promoting community-based seed production to improve seeds availability at affordable cost for local farmers, through CBO identified seed producers.
- Linking community seed producers to private seed companies to enhance availability of improved seeds across all regions of Ghana.
- Promoting cereal–legume integration through rotation and intercropping to improve system productivity.
- Promoting crop–livestock interaction for system integration and bio-resource flow.
- Conducting training on improved crop management practices, pesticide use, and *Striga* control for participating CBOs and farmers. Such training will include leadership, communication, and encourage farmer-to-farmer learning.

Livestock production interventions

- Sourcing improved breeds of poultry, sheep, and goats from research institutes for multiplication and upgrading of local breeds.
- Promoting poultry, sheep, and goat multiplication and share schemes especially among women and youths to improve their economic base.
- Supporting community livestock health workers (CLHWs) to supplement veterinary services at the community level. As with crop and soil management interventions this can involve CBO selection of suitable CLHWs.
- Conducting training on improved livestock management practices for participating CBOs and farmers at community level. Such training in common with crop intervention training will include leadership, communication, and encourage farmer-to-farmer learning.

Processing and Market interventions

- Conducting training on soybean utilization and processing especially for women groups.
- Linking CBOs and farmers to input-output markets, especially for soybean and maize.
- Conducting training for farmer groups on processing and marketing skills.
- Collecting and sharing market information, especially on prices, among farmer groups.

Advocacy and policy issues

- Liaising with traditional leaders and policymakers to reduce the activities of small miners, charcoal gatherers and bush burners to reverse land degradation.
- Liaising with policymakers to improve market infrastructure and market days.
- Involving both government and NGOs in project implementation and capacity building activities of the project. This will give emphasis to the establishment of partnerships between stakeholders to act as innovation platforms that will sustain project activities into the future.

Key to scaling up successful interventions will be farmer-to-farmer dissemination of proven technologies. Hence the emphasis placed on CBO selection of lead farmers for crop and livestock interventions and community seed producers. Lead farmers will be supported to conduct on-farm testing to generate solutions to the production constraints and opportunities identified, while community seed producers will be supported to produce certified seed of improved crop varieties. These crop varieties, which should be multi-stress resistant (resistant to drought, *Striga*, pests, and diseases), extra-early or early maturing, and high yielding will be sourced from both national and international research institutes for inclusion in the project program.

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